**U.S. HOUSE OF REPRESENTATIVES**
**COMMITTEE ON SCIENCE**
**SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS**
**HEARING CHARTER**

# "Views of the NIST Nobel Laureates on Science Policy"

**May 24, 2006**
**9:30-11:30 a.m.**
**2318 Rayburn House Office Building**

## Purpose

On Wednesday May 24, 2006, at 9:30 a.m., the Subcommittee on Environment, Technology, and Standards of the House Committee on Science will hold a hearing to learn the views of the Nobel Prize winners from the National Institute of Standards and Technology (NIST) on science policy.

## Witnesses

**Dr. William D. Philips** is a scientist in the physics division at the NIST laboratory in Gaithersburg, Maryland. He won the 1997 Nobel Prize for physics.

**Dr. Eric Cornell** is a senior scientist at the NIST laboratory in Boulder, Colorado, and a fellow at JILA, the joint institute between NIST and the University of Colorado. He won the 2001 Nobel Prize for physics.

**Dr. John (Jan) Hall** is a scientist emeritus at the NIST laboratory in Boulder, Colorado and a fellow at JILA, the joint institute between NIST and the University of Colorado. He won the 2005 Nobel Prize for physics.

## Overarching Questions

The hearing will address these overarching questions:

1. Why has NIST been so successful at cultivating Nobel Prize winners?

2. What are the implications of the Nobel Prize-winning research at NIST and how can that work get used outside of NIST?

3. What steps are most necessary to improve U.S. performance in math, science and engineering, and U.S. competitiveness?

## Overview of NIST

The National Institute of Standards and Technology, created by Congress in 1901, is the nation's oldest federal laboratory. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST has two laboratory campuses, one in Gaithersburg, MD, and the other in Boulder, CO, and a joint institute for physics research with the University of Colorado at Boulder, known as JILA.

The NIST's research programs are carried out through eight laboratories:

- Building and Fire Research Laboratory
- Chemical Sciences and Technology Laboratory
- Electronics and Electrical Engineering Laboratory
- Information Technology Laboratory
- Manufacturing Engineering Laboratory
- Materials Science and Engineering Laboratory
- Physics Laboratory
- Technology Services Laboratory.

In addition, NIST houses major facilities that play a critical role in measurement and standards research, as well as supporting technology development for future industries. These facilities include the atomic clock, the National Center for Neutron Research, and the National Nanotechnology and Nanometrology Facility.

## NIST's FY 2007 Budget Request

NIST is one of the three agencies included in the President's American Competitiveness Initiative. (The other two are the National Science Foundation and the Department of Energy Office of Science.) The Initiative, announced in the State of the Union message and included in the Fiscal Year (FY) 2007 budget, calls for a doubling of the combined budgets of the three agencies over 10 years. (The Initiative does not include NIST's extramural research programs – the Manufacturing Extension Partnership program and the Advanced Technology Program.)

For details on the NIST budget, see the chart below.

The proposed increase in laboratory programs for FY 2007 would fund major upgrades and enhancements of NIST's two national research facilities in Gaithersburg, MD: the NIST Center for Neutron Research and the Center for Nanoscale Research and Technology. The budget request would also fund expansion of NIST's existing presence at the National Synchrotron Light Source at Brookhaven National Laboratory. The request for NIST will increase the ability of U.S. researchers to develop, characterize, and manufacture new materials In addition, the proposed budget would increase NIST laboratory and technical programs directed at solving measurement and other technical problems in energy, medical technology, manufacturing, homeland security, and public safety.

## NIST Appropriations and Reauthorization

In May 2005, the House passed H.R. 250, *The Manufacturing Technology Competitiveness Act*, which included authorization language and funding levels for NIST, using the President's FY 2006 request of $426 million as a baseline. The Senate Commerce Committee recently reported out S.2802, a bill that also includes a NIST authorization.

| NIST Appropriations FY 05-FY 07 | | | | | | H.R. 250 Authorization | | |
|---|---|---|---|---|---|---|---|---|
| **Account** | FY 05 Actual | FY 06 Request | FY 06 Actual | FY 07 Request | $ Change FY07 request vs. FY06 actual | FY 06 | FY 07 | FY 08 |
| **NIST Labs** | 378,764 | 426,267 | 399,869 | 467,002 | 67,133 | 426,267 | 447,580 | 456,979 |
| **Construction** | 72,518 | 58,898 | 175,898 | 67,998 | (107,900) | 58,898 | 61,843 | 63,389 |
| **ATP** | 140,399 | 0 | 80,000 | 0 | (80) | 0 | 0 | 0 |
| **MEP** | 107,544 | 46,800 | 106,000 | 46,332 | (59,668) | 110,000 | 115,000 | 120,000 |
| **TOTAL** | **699,225** | **531,965** | **761,767** | **581,332** | **(180,435)** | **595,165** | **624,423** | **640,368** |

## How NIST Supports Promising Scientists

There are several means available to NIST to reward or encourage scientists who are pursuing promising avenues of research: the Competence program, the Presidential Early Career Award for Scientists and Engineers (PECASE), and increasing support for individual scientists from NIST's base funding. Each of NIST's Nobel laureates benefited from one or all of these programs.

The NIST Competence program was established to provide five years of funding for high-priority research by NIST researchers. The focus is to develop new technical competence required to support national measurement science or standards. If, at the end of the five years, the research has been successful, the Competence funding can be replaced with more permanent program funding to continue the research. For example in 1992, John Hall was awarded $340,000 per year for five years in Competence funding to pursue research "Beyond Quantum Limits," funding that he used in part to hire Eric Cornell to create a Bose-Einstein Condensate (BEC).

The NIST Director can nominate NIST scientists for PECASE, which was established in 1996 to support the extraordinary achievements of young scientists and engineers in the federal government. Dr. Cornell received this award in 1996. NIST and the Department of Commerce also have some internal awards that are made in recognition of outstanding service by their employees.

Finally, the NIST Director can support talented scientists with additional funding from the NIST laboratory budget. For example, in recognition of Dr. Cornell's achievement of BEC in 1995, the NIST Director gave him an additional $250,000 in base lab funding. Dr. Cornell has stated that this research funding, received without making a request or proposal, was one of the reasons he decided to stay at NIST, despite personally lucrative offers elsewhere.

## Nobel Prize-winning work at NIST

Two of the NIST Nobel laureates won their Prize for work related to low-temperature physics. NIST scientists conduct low-temperature physics research because understanding the properties of atoms and materials at low temperatures can improve the science of measurement, which is critical to improving the competitiveness of U.S. industry.

One application of low-temperature physics is technology to improve the accuracy of atomic clocks. By cooling atoms of cesium, scientists have made atomic clocks that are a billion times more accurate than an ordinary wristwatch. Highly accurate clocks are essential to navigation instruments and other devices that use the Global Positioning System (GPS), because the GPS depends on atomic clocks that circle the earth in satellites. By comparing time information from several satellites, GPS receivers in cars, airplanes, or hand-held instruments can determine their location on earth with an accuracy of just a few meters. The more precise, accurate, and better synchronized the clocks, the more accurate the associated locational data becomes.

**Dr. William D. Phillips**' Nobel Prize, which he shared with Dr. Steven Chu and Dr. Claude Cohen-Tannoudi in 1997, was awarded for the development of a technique called "laser trapping and cooling." This technique allows researchers to use lasers as pincers to immobilize individual or small groups of atoms.

**Dr. Eric Cornell** won his Nobel Prize, which he shared with Dr. Carl Wieman, for creating a Bose-Einstein Condensate (BEC), a previously unobserved state of matter, predicted in 1920s by Albert Einstein and an Indian colleague. In the BEC state, a gas, cooled to super-low temperatures, behaves like a superfluid – neither a gas nor a liquid nor a solid. Cornell and Wieman used the laser cooling technique pioneered by Dr. Phillips, together with another technique.

**Dr. Jan Hall** won his Nobel Prize, which he shared with Theodor Hänsch, for his contributions to laser-based precision spectroscopy, including the development of the "optical frequency comb" technique. The optical frequency comb is a new measuring method for the frequency of light, and is critical for the solution to the problem of measurements, including the standard definition of the meter. Optical frequency combs are now commercially available.

## Witness Questions

The witnesses were asked to briefly describe the research that led them to the Nobel prize-winning discoveries, and answer the following questions:

1. Describe the role that NIST plays in your field of science.

2. Describe the steps that you had to take from the development of the initial scientific concepts through to the experiments for which you won the Nobel Prize. What are the applications or potential applications of your discoveries and what steps have been or will be taken to translate this new science into technology and other applications?

3. What do you believe are the most important steps the Federal government should take to improve the competitiveness of U.S. scientific research?